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Performance Analysis of Combined Cooperative Diversity and Multiuser Diversity

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ABSTRACT: This paper presents the combined use of cooperative diversity and multiuser diversity. Round robin based fair scheduling (RRFS) is used to achieve the benefit of Cooperative diversity and Multiuser diversity in multi-source and multi-relay amplify and forward relay networks. Multiuser diversity uses user scheduling scheme to select high quality channel users based on the channel state information. This cause transmission unfairness .In this paper, a Round robin scheduler is used to achieve fairness among users .A joint source relay pair selection is employed in the relay phase, which helps the best relay to transmit the worst source in each relay time slot..

KEYWORDS: Cooperative diversity, Multiuser diversity, Round Robin Fair Scheduling.

I.INTRODUCTION

Diversity is a powerful communication technique that provides wireless link improvements at relatively low cost. Diversity plays an important role in combatting fading and co-channel interference. It exploits the random nature of radio propagation by finding independent signal path for communication. The performance of multiuser relay network has been performed using single amplify-and-forward relay [1]. All the relay participating and relay selection is considered in multiuser cooperative relay networks with the help of relays the cooperative diversity can be obtained [2]. Cooperative communications significantly improve the performance of wireless networks with the help of relay nodes, the performance of multiuser diversity is analysed in the multiuser two-hop cooperative relay networks [3]. The performance of combined use of cooperative diversity and multiuser diversity is analysed by using joint selection scheme [4]. It is used to select the best source-relay pair to access the channel is proposed.

In this paper, we specifically study the fair scheduling scheme for combining cooperative diversity and multiuser diversity in multi-source multi-relay networks. Round robin scheduling guarantees each user has the same transmission opportunity in both long term and short term transmission. Best relay to help the worst source's transmission can be obtained with round robin scheduling.

This paper is organized as follows: In section 2, system model described. In section 3, phases for transmission are described. In section 4, Performance analysis is described. Finally section 5 concludes the paper.

II.SYSTEM MODEL

The system model consists of N sources and M relays. All the sources transmit their individual information to one destination with the help of M relays. All the nodes are assumed to have single antenna and transmit with unit power. It cannot send and receive the information simultaneously. It works in half duplex mode.

III.PHASES FOR TRANSMISSION

The whole transmissions are been divided into two phases.

- Broadcast phase
- Relay phase

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Broadcast Phase

In broadcast phase each source broadcast its data in turn. All sources transmit in a round robin manner, hence the broadcast phase occupies N time slot. The received signal of the relay j and the destination from the source i are

$$y_{S_iR_j} = h^{(0)}_{S_iR_j} x_i + n_{S_iR_j}$$

$$y_{S_iD} = h^{(0)}_{S_iD} x_i + n_{S_iD}$$

Where, $h^{(0)}_{S_iR_j}$ - Fading coefficients of the link source to relay, $h^{(0)}_{S_iD}$ - Fading coefficients of the link source to destination, x_i - Transmitted

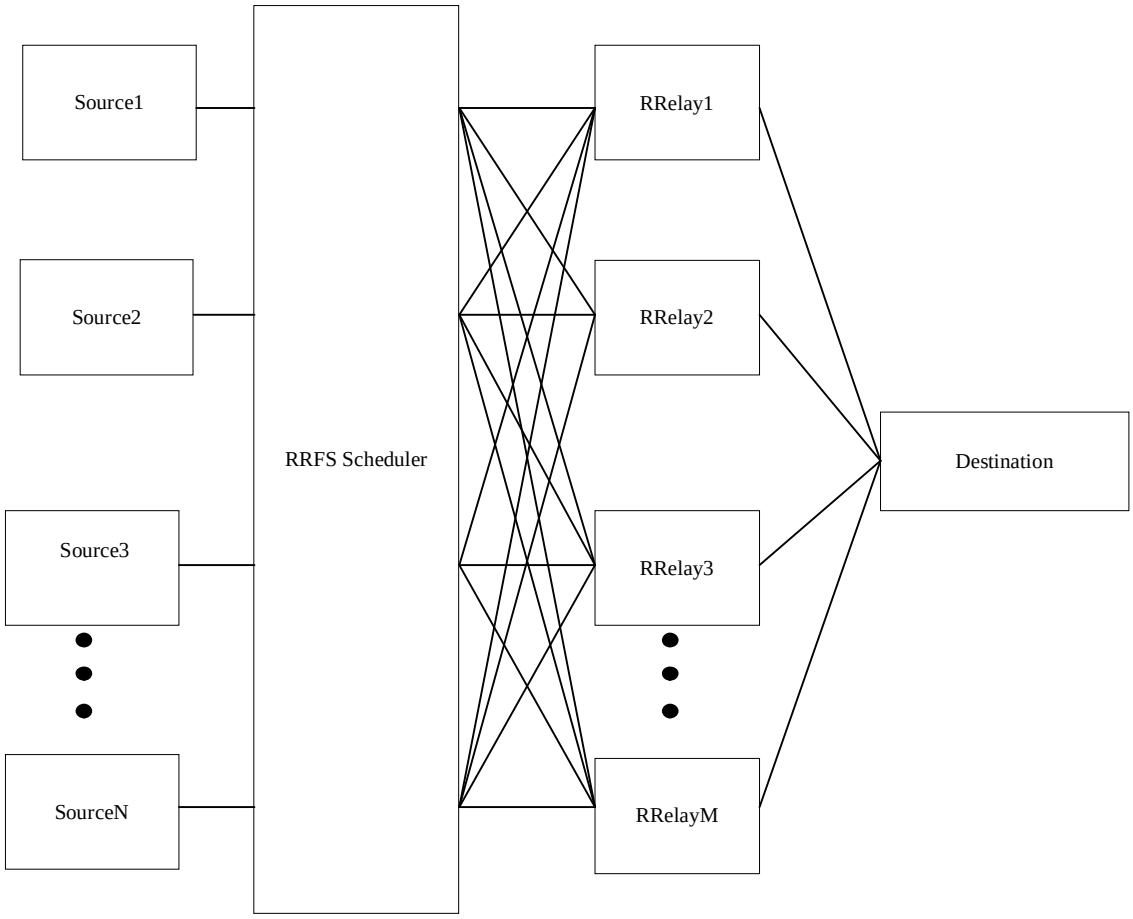

Fig 1.1 System Model

symbol of S_i , $n_{S_iR_j}$ & n_{S_iD} - AWGN with zero mean and variance .

The SNR at the destination from S_i after the broadcast phase is

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$$\rho_i^{(1)} = \left|h_{S_iD}^{(0)}\right| \Big/ \sigma^2$$

$\rho_i^{(1)}$ -SNR of the received signal

Relay Phase

During transmission period, all the relays participate one by one. The relay phase lasts for M Time slots.It employs source-relay pair selection and AF transmission. Source relay pair selection is used to select the source and relay for transmission. Best relay helps to transmit the worst source at each time slot. For each time slot the worst source is selected according to the quality records stored at destination and one relay in operation amplifies the received signal from the selected source and forwards the signals to destination. Finally the destination performs data combining and updates the quality record of each source.

In the k[th] relay time slot, the destination first selects the worst source and broadcasts its index number l_k .

It is given in below equation

$$l_k = \arg \min_{i=1....N} \rho_i^{(k)}$$

Then the best relay with index number m_k is chosen to help the transmission of S_{l_k} .To overcome the CD problem we must give the opportunities to update their observations of x_{l_k} during the relay phase. Then the k+1th relay time slot begins. The relay phase lasts for M time slots. The whole transmission finishes after the relay phase.

IV.PERFORMANCE ANALYSIS

Outage Probability

Outage probability is defined as the probability that the signal-to-interference (SIR) of a received signal is below a given threshold. In this scheme, Outage probability of RRFS can be computed as

$$P_{out}(r) = P_r(\log_2(1+\rho_i^{(N+1)}) < r)$$
$$\leq \prod_{t=1}^{N+M+1} P_r(\log_2(1+\beta_t) < r)$$

Multiuser diversity uses user scheduling scheme to select high quality channel users based on the channel state information. This cause transmission unfairness. A Round robin scheduler is used to achieve fairness among users .A joint source relay pair selection is employed in the relay phase, which helps the best relay to transmit the worst source in each relay time slot.

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V.SIMULATION RESULT

The figure 1.2 shows the comparison between Multiuser diversity and CD-MUD combined selection.

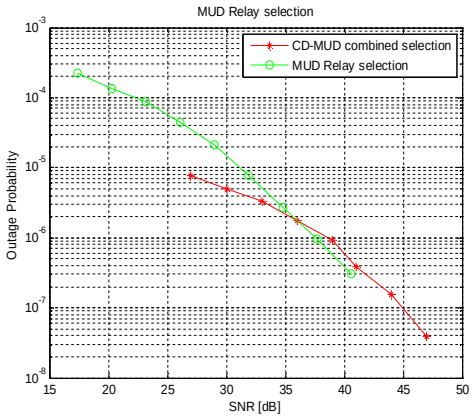

Figure 1.2 SNR Vs Outage Probability

The figure 1.3 shows the simulation result for SNR Vs Outage Probability by varying the number of sources and relays. When RRFS scheduler is introduced the performance of outage probability is improved.

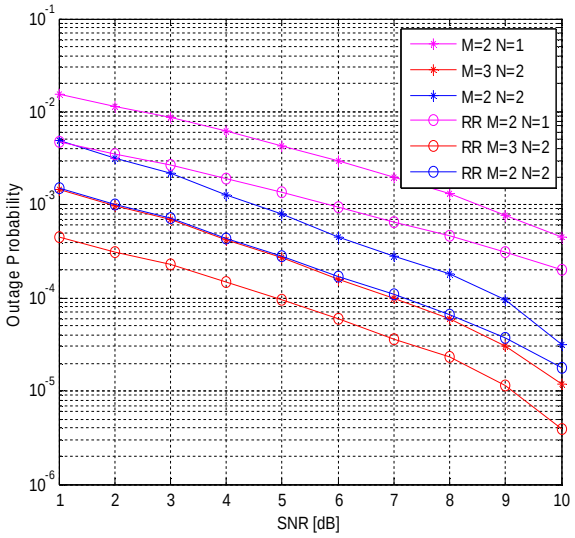

Figure 1.3 SNR Vs Outage Probability

VI. CONCLUSION

In this paper, a multisource multi relay network is designed in such a way it supports both cooperative diversity and multi user diversity mechanisms. To spread the fairness to all available sources the joint selection of scheduling best user in worst relay network is adapted. Round robin Fairness selection method ensures that all the sources are periodically participated in the communication. RRFS achieves better outage probability and total diversity order of N+M+1 while maintaining transmission fairness.

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